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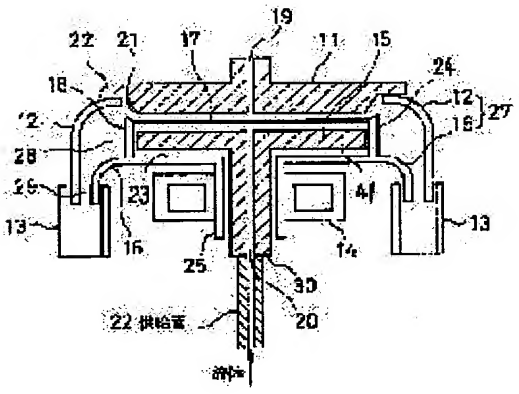
(54) FLUID TREATMENT OF MATERIAL TO BE TREATED AND DEVICE THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To treat the both of the surface and the back of a material to be treated with a fluid with high cleanness and at a low price without generating worn particles and without leaking the fluid.
SOLUTION: A material to be treated holding means 18 for holding a material to be treated 17 and a rear shield plate 15 for preventing the back of the material to be treated from being contaminated by turbulence are mechanically separated. The rear shield plate 15 is fixed just the same as a surface shield plate 11 and only the material to be treated holding means 18 is rotated to enable this device to rigidly connect a feeding pipe 22 for feeding a fluid through the rear shielding plate 15 to the rear shielding plate 15. Further, a circulating system is installed so that the fluid by which the surface of the material to be treated is treated, is recovered in a recovery cylinder 13 and is circulated to feed it to the back of the material to be treated from the feeding pipe 22.



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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]In order to prevent polluting a surface and rear surface of a processed material, a surface and rear surface of said processed material is covered with a front shield and a back shield, Rotate a processed material relatively to said table shield and a back shield, and a fluid is supplied between the surface of said processed material, and said table shield, Collect processed fluids which performed fluid processing of the surface of said processed material, and performed fluid processing on said surface of a processed material, and a fluid whose collected processed material surface has been processed [this] is supplied between a rear face of said processed material, and said reverse side shield, A fluid processing method of a processed material performing fluid processing of a rear face of said processed material.
[Claim 2]Collect processed fluids which performed fluid processing on said rear face of a processed material, and a fluid whose collected processed material rear face has been processed [this] is also supplied between a rear face of said processed material, and said reverse side shield, A fluid processing method of the processed material according to claim 1 performing fluid processing of a rear face of said processed material.
[Claim 3]In order to arrange on a periphery of said processed material so that coaxial rotation of the hood for fluid prehension may be carried out with said processed material or said table shield, and said reverse side shield, and to collect fluids processed [said], A fluid processing method of the processed material according to claim 1 which caught a processed fluid which rotates said hood with said processed material or said table shield, and said reverse side shield, gives a centrifugal force to a fluid processed [said], and is discharged by this by method of the outside of a diameter direction of said processed material with said hood.
[Claim 4]A fluid processing method of the processed material according to claim 1 or 2 characterized by mixing a processed fluid which performed fluid processing on said surface of a processed material in a processed fluid which performed fluid processing on said rear face of a processed material, and making it collect in it.
[Claim 5]A fluid processing method of the processed material according to any one of claims 1 to 3 choosing a fluid supplied according to fluid processing which should be performed to said processed material, and performing fluid processing of a surface and rear surface of said processed material.
[Claim 6]A fluid processor of a processed material characterized by comprising the following.
Processed material holding mechanism holding a processed material.
A front shield and a back shield which cover the surface and a rear face of a processed material which are held at said processed material holding mechanism, respectively, and rotate relatively to said processed material holding mechanism.
A fluid supply system which supplies a fluid between said table shield and said processed material surface through a feed hopper established in said table shield.
A hood which catches a processed fluid which performed fluid processing on the surface of a processed material at least, A recovery means which collects said processed fluids caught with said hood from an exit established in said hood, The circulatory system which collects processed fluids which supplied said processed fluid collected by said recovery means between said reverse

side shield and a processed material rear face through a feed hopper established in said reverse side shield in order to perform fluid processing on said rear face of a processed material, and performed fluid processing on said rear face of a processed material to said recovery means.

[Claim 7]Said hood is arranged so that coaxial rotation may be carried out with said processed material holding mechanism or said table shield, and a back shield, A fluid processing method of the processed material according to claim 6 constituted so that a processed fluid which performed fluid processing on the surface of a processed material discharged from a periphery of said processed material in response to a centrifugal force generated by said rotation, and a processed fluid which performed fluid processing on a rear face of a processed material may be caught.
[Claim 8]A fluid processor of the processed material according to claim 6 or 7 which rotated said processed material holding mechanism and fixed said table shield and a back shield.
[Claim 9]A fluid processor of a processed material characterized by comprising the following.
The axis of rotation of hollow which established in an inside a feed hopper which provided said processed material holding mechanism in said reverse side shield.
An attaching part which is provided in a periphery of said processed material and holds a periphery of said treatment object.
A connecting part which extends from said axis of rotation to near the periphery of said reverse side shield to a method of the outside of a diameter direction, and connects said attaching part with said axis of rotation.

[Claim 10]Said hood the front of a course of a processed fluid discharged from a periphery of a processed material A hood outside a wrap, A fluid processor of the processed material according to any one of claims 6 to 9 in which it comprises a hood in a wrap and an inner hood rotates at least the lower part of a course of a fluid processed [said] on said processed material holding mechanism and the same axle.
[Claim 11]A fluid processor of the processed material according to any one of claims 6 to 10 which constituted said processed material holding mechanism and said hood in one.
[Claim 12]A fluid processor of the processed material according to any one of claims 6 to 11 which different-body-izes said processed material holding mechanism and said hood, and could be made to carry out a roll control individually, respectively.
[Claim 13]A fluid processor of the processed material according to any one of claims 6 to 12 equipping said circulatory system with a means to adjust circulating flowing quantity of a fluid.
[Claim 14]A fluid processor of the processed material according to claim 13, wherein a means to adjust said circulating flowing quantity is a cyclone separator using a centrifugal force of a fluid.
[Claim 15]A fluid processor of the processed material according to any one of claims 6 to 14, wherein said table shield and a back shield are formed with carbon or a fluoro-resin.
[Claim 16]A fluid processor of the processed material according to any one of claims 6 to 15, wherein said recovery means is fixed and a lower part outlet of said hood is inserted in a recovery means of this immobilization by non-contact.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention starts the fluid processing method of a processed material required for the manufacturing process of a thin film device, and its device, and relates to the fluid processing method of the suitable processed material for the semiconductor manufacturing process as which a high detergency is required especially, and its device.
[0002]
[Description of the Prior Art]In recent years, the minuteness making of structure follows thin film devices, such as a semiconductor, a liquid crystal display, and a magnetic disk, and since it is the performance of these devices, and improvement in the yield of manufacture, an advanced detergency of a manufacturing process is desired. If it says in the example of a semiconductor wafer, a thing of 0.2 micrometers or more the size of the foreign matter which should be removed Ten or less per wafer. It is required that the thickness of the oxide film formed when, as for the quantity of contaminant of a metal ion, below 10^{10} atom / cm^2 touch air shall be 1 nm or less.
[0003]The sheet process method of various kind mixing production becoming inescapable, and the device which can respond to two or more manufacturing processes being needed, and processing one tabular processed material (it may only be hereafter called a processed material) at a time is being put in practical use.
[0004]As the 1st conventional example, the substrate treatment of JP,8-31690,A shown in drawing 7 is mentioned. This conventional example fixes the tabular processed material 53 to the substrate attachment component 54, and it rotates (not shown [the pivot means]). Fluid processing of the treating solution is injected and carried out only to the surface of the tabular processed material 53 from the pure water jet nozzle 51, covering the surface of the tabular processed material 53 with the shield (a front shield is called hereafter) 52, in order to prevent the processed material surface being polluted by the turbulent flow generated by rotation of the tabular processed material 53. In this 1st conventional example, since the shield (a back shield is called hereafter) was not installed in the rear face of the tabular processed material 53, there were the following faults.
[0005]In addition to fluid processing of the rear face not being carried out, a processed material rear face is polluted by the turbulent flow generated with the rear face of the tabular processed material 53. If a processed material rear face is polluted, transfer contamination of the surfaces in contact with a processed material rear face, such as a processed material transportation arm and a processed material holding fixture (not shown), will be carried out, a subsequent processed material rear face will be further polluted with a subsequent process, and quality will be reduced. Especially at the process that heat starts, the contaminant adhering to a processed material rear face volatilizes, the processed material surface is arrived at, and fatal contamination is produced on the processed material surface.
[0006]As the 2nd conventional example that can cancel this fault, the disposal method and device of a work of JP,8-78368,A which are shown in drawing 8 are mentioned. In this conventional example, also cover the rear face of a processed material with the back cutoff plate

62, and contamination on the rear face of a processed material by the aforementioned turbulent flow is prevented, and fluid processing of the processed material surface and the rear face is carried out simultaneously.

[0007]By the way, it is indispensable to make it rotate the processed material 64 to carry out fluid processing of the processed material surface uniformly. With this point, the holding fixture of the processed material 64 is mechanically formed in the back shield 62 in this 2nd conventional example at one, and the processed material 64 and the back shield 62 are simultaneously rotated by the motor 65. From the supply tank 74, a fluid switches the cross valves 67 and 68 and is carrying out branching supply at the front shield 61 and the back shield 62. Although not clearly written in the 2nd conventional example about the connection structure of the feed pipe 76 to the back shield 62 here, one back shield 62 is rotating and the feed pipe 76 of another side is generally immobilization. The numerals 70 are new solution feed zones.

[0008]

[Problem(s) to be Solved by the Invention]However, the following problems were among the 2nd conventional example mentioned above.

[0009]First, the fluid which processed the rear face is not recyclable even if it collects to the fixed hood 63, since it is polluted. For this reason, the cross valve 69 must be switched and the fluid collected by the fixed hood 63 must be discarded. However, if it discards, a lot of fluids will be consumed. Although it seems to carry out circulation use of the fluid which processed the rear face apparently in the distribution diagram of drawing 8, since the fluid which processed the rear face has large contamination, even if it filters with the filters 72 and 75, circulation use of it cannot be carried out.

[0010]If the fixed feed pipe 76 which supplies a fluid is connected next so that a fluid may not leak to the feed hopper established in the rotating back shield 62, a terminal area will rub. Friction powder mixes in a fluid, pollutes a fluid, and reaches the front shield 61 through the fixed hood 63, the recovery tank 71, the pump 73, and the supply tank 74, not only a processed material rear face but also the processed material surface is polluted, and quality is reduced fatally.

[0011]But if the fixed feed pipe 76 which supplies a fluid, and the rotating back shield 62 are connected so that it may not rub mutually, a fluid will leak from a terminal area and the staining substance contained in a fluid when it is many will corrode parts, such as the motor 65.

[0012]Thus, in the sheet process which requires rotation of a processed material for uniform processing, the method and device which still carry out fluid processing of the processed material to high clarification were not realized.

[0013]The technical problem of this invention is in solving the problem of the above-mentioned conventional technology, and there is the 1st technical problem in carrying out the cyclic use of waste water of the fluid, and providing the fluid processing method of the processed material [it is cheap and] which can carry out fluid processing to high clarification. There is the 2nd technical problem in providing the fluid processor of the processed material which can carry out fluid processing of the processed material rear face to high clarification with the processed material surface. the 3rd technical problem does not generate friction powder and does not leak a fluid -- high -- it is in providing the fluid processor of the processed material which can obtain a pure processed material.

[0014]

[Means for Solving the Problem]The 1st method invention covers a surface and rear surface of said processed material with a front shield and a back shield, in order to prevent polluting a surface and rear surface of a processed material, Rotate a processed material relatively to said table shield and a back shield, and a fluid is supplied between the surface of said processed material, and said table shield, Collect processed fluids which performed fluid processing of the surface of said processed material, and performed fluid processing on said surface of a processed material, and a fluid whose collected processed material surface has been processed [this] is supplied between a rear face of said processed material, and said reverse side shield, It is the fluid processing method of a processed material performing fluid processing of a rear face of said processed material.

[0015]Processed materials are tabular boards, such as a semiconductor wafer, glass for liquid crystal displays, and a magnetic disk. It requires that processed material holding mechanism is what resists a centrifugal force generated by rotation and can hold a processed material.
[0016]In the 1st invention, fluids which performed processing on the surface of a processed material are collected, circulation feed of this is carried out to a processed material rear face, and processing on a rear face of a processed material is performed. Although fluids which performed processing on the surface of a processed material cannot be collected and processing on the surface of a processed material cannot be performed again, even if it performs fluid processing using a fluid which performed processing on the surface of a processed material, it is convenient to a case on a rear face of a processed material compared with the processed material surface where a degree of contamination is large in any way. Since processing on a rear face of a processed material is performed using a fluid which performed processing on the surface of a processed material, the amount of fluid used can be reduced and cheap fluid processing can be realized.
[0017]If especially rotating is only processed material holding mechanism except for a hood and a front shield and a back shield are kept from rotating, A feed hopper established in a front shield, a fluid supply system, and a feed hopper and the circulatory system which were provided in a back shield do not generate friction powder, and can connect easily a feed hopper and the circulatory system which were provided in a back shield in the state where there is no leakage. Therefore, purer and cheap fluid processing is realizable.
[0018]In the 1st invention, it is preferred to collect processed fluids which performed fluid processing on said rear face of a processed material, to also supply a fluid whose collected processed material rear face has been processed [this] between a rear face of said processed material and said reverse side shield, and to perform fluid processing of a rear face of said processed material. Since a fluid which performed processing on a rear face of a processed material is circulated and processing on a rear face of a processed material is performed, the amount of fluid used can be reduced further and cheaper fluid processing can be realized.
[0019]Arrange so that coaxial rotation of the hood which catches a fluid which performs said fluid processing and is discharged by periphery of a processed material in the 1st invention may be carried out with said processed material holding mechanism or a front shield, and a back shield, and by rotation of said hood. A centrifugal force is given to a processed fluid discharged by performing said fluid processing with said processed material holding mechanism to rotate or a front shield, and a back shield, and a processed fluid discharged by this by method of the outside of a diameter direction is caught with said hood, and it may be made to collect them. Since a hood is rotating with processed material holding mechanism or a front shield, and a back shield, a centrifugal force works in a discharged processed fluid, and a flow to a shaft direction of processed material holding mechanism or a front shield, and a back shield is suppressed. For this reason, discharged processed fluids are collected effectively to a recovery means, without beginning to leak from a shaft direction. Thus, since a hood is rotated, a centrifugal force is given to exhausted fluid with processed material holding mechanism or a front shield, and a back shield and a flow to a shaft direction was suppressed, fluids can be collected effectively and cheap fluid processing can be realized.
[0020]In the 1st invention of the above, fluids which performed processing on said surface of a processed material are mixed and collected in a fluid which performed processing on said rear face of a processed material, circulation feed of this collected fluid is carried out to said processed material rear face, and it may be made to perform processing on said rear face of a processed material. By mixing and collecting fluids which performed processing on a rear face of a processed material in a fluid which performed processing on the surface of a processed material according to this. Since dirt of a fluid which performed processing on a rear face of a processed material was made to dilute, processing on a rear face of a processed material can be performed now by making a processed material rear face circulate through a collected fluid, and much more economical fluid processing can be realized.
[0021]A fluid supplied according to processing which should be performed to said processed material is chosen, and it may be made to perform processing of a surface and rear surface of

said processed material. As processing which should be performed to a processed material, if washing processing is mentioned as an example, it will become one set at three processes of washing, rinse, and desiccation. In this case, use penetrant removers, such as ammonia + hydrogen-peroxide-solution + water of specified proportion, and hydrofluoric acid + water, for washing, ultrapure water is used for rinse, and inactive gas, such as argon and N_2 gas, is used for desiccation. Since according to this a fluid supplied according to processing is chosen and it was made to perform processing of a surface and rear surface of a processed material, communalization of a process can be attained and fluid processing efficiency improves further.

[0022]A front shield and a back shield which the 2nd device invention covers the surface and a rear face of a processed material which are held at processed material holding mechanism holding a processed material, and said processed material holding mechanism, respectively, and rotate relatively to said processed material holding mechanism, A fluid supply system which supplies a fluid between said table shield and said processed material surface through a feed hopper established in said table shield, A hood which catches a processed fluid which performed fluid processing on the surface of a processed material at least, A recovery means which collects said processed fluids caught with said hood from an exit established in said hood, Said processed fluid collected by said recovery means is supplied between said reverse side shield and a processed material rear face through a feed hopper established in said reverse side shield in order to perform fluid processing on said rear face of a processed material, It is a fluid processor of a processed material provided with the circulatory system which collects processed fluids which performed fluid processing on said rear face of a processed material to said recovery means.

[0023]If a fluid is supplied to a feed hopper established in a back shield from the circulatory system, processing on a rear face of a processed material will be performed. A processed fluid which performed processing of a surface and rear surface of a processed material is caught with a hood, and is collected and mixed by recovery means. Since a fluid greatly polluted with performing processing on a rear face of a processed material at this time is diluted with performing processing of the surface of a processed material with a fluid stopped by comparatively small contamination, a degree of contamination falls. Therefore, even if it performs processing on a rear face of a processed material by making a processed material rear face circulate through mixing fluid in which this degree of contamination fell, trouble is not produced at all in fluid processing.

[0024]In the 2nd invention, it is arranged so that coaxial rotation of said hood may be carried out with said processed material holding mechanism or said table shield, and a back shield, It is preferred to consider it as a hood which catches a processed fluid which performed fluid processing on the surface of a processed material discharged from a periphery of said processed material in response to a centrifugal force generated by said rotation, and a processed fluid which performed fluid processing on a rear face of a processed material.

[0025]If a front shield and a back shield are made immobilization to processed material holding mechanism, it is not generated by friction powder in a terminal area, but the connection of a stationary system fluid supply pipe to these feed hoppers can adopt a fixing method which does not leak a fluid. Since a fluid is supplied from a stationary system fluid supply pipe to a feed hopper established in a front shield and a back shield which were both fixed, Compared with a case where a fluid is supplied to a feed hopper established in a back shield which is mechanically united with processed material holding mechanism, and rotates, a feed hopper and a fluid do not generate friction powder in a terminal area with a feed pipe, and it can connect so that a fluid may not be leaked. therefore, friction powder is not mixed -- high -- pure fluid processing is realizable and parts, such as a rotating driving source, can be prevented from corroding with a staining substance contained in a fluid by leakage of a fluid.

[0026]When processed material holding mechanism is fixed and it rotates a front shield and a back shield, a bearing with little friction is used and friction is kept from arising as much as possible in a terminal area.

[0027]When it is made to rotate said processed material holding mechanism, in the 2nd invention

the processed material holding mechanism, It may constitute from the axis of rotation of hollow which established a feed hopper established in said reverse side shield in an inside, an attaching part which is provided in a periphery of said processed material and holds a periphery of said treatment object, and a connecting part which extends from said axis of rotation to near the periphery of said reverse side shield to a method of the outside of a diameter direction, and connects said attaching part with said axis of rotation. Said hood comprises [course / of a fluid discharged from a periphery of a processed material] a hood in a wrap in the lower part of a hood outside a wrap, and a course of said fluid, and it may be made for an inner hood to rotate on said processed material holding mechanism and the same axle at least.

[0028]Rotating processed material holding mechanism and said hood may be constituted in one, and said processed material holding mechanism and said hood are different-body-ized, and it is made to carry out a roll control individually, respectively. Said circulatory system can be equipped with a means to adjust circulating flowing quantity of a fluid, and a means to adjust circulating flowing quantity in this case may consist of cyclone separators using a centrifugal force of a fluid.

[0029]It is preferred that said table shield and a back shield are carbon or a fluoro-resin. it is preferred that said recovery means is fixed, and an exit of said hood is boiled and inserted in a recovery means of this immobilization by non-contact.

[0030]

[Embodiment of the Invention]A drawing is used for below and an embodiment of the invention is described to it. A table and a back shield are fixed, and it rotates, a processed material being held, and the method by which fluids are collected is explained using drawing 1.

[0031]The front shield 11 and the back shield 15 are being fixed in the meaning which is not rotated (not shown [the fixing method]). The front shield 11 can be pulled up when holding the processed material 17. The front shield 11 and the back shield 15 are the fields which counter the processed material 17, and they are arranged at abbreviated parallel, without contacting the processed material 17. What is necessary is just to define the distance with the processed material 17, the front shield 11, and the back shield 15 according to the kind of fluid, and the purpose of fluid processing.

[0032]Said table shield 11 is carrying out discoid whose path is a little larger than the tabular processed material 17, and it prevents polluting the processed material surface with the turbulent flow generated by rotation of the tabular processed material 17 by covering the surface of the tabular processed material 17. The front feed hopper 19 is protruded in the center of the front shield 11, from this front feed hopper 19, a fluid is supplied between the processed material surface and the front shield 11 which counters this, and processing on the surface of a processed material is performed. the collar thinner than the overall thickness of the front shield 11 so that it may see in a sectional view in the end of the tapered surface 21 on it in which the tapered surface 21 is formed in the periphery of the front shield 11 toward the method of the outside of the surface side from the rear-face side -- the hood receiving part 22 is formed outside **.

[0033]Said reverse side shield 15 is carrying out discoid whose path is a little smaller than the tabular processed material 17, and it prevents polluting a processed material rear face with the turbulent flow generated by rotation of the tabular processed material 17 by covering the rear face of the tabular processed material 17. The back feed hopper 20 longer than said table feed hopper 19 is protruded in the center of the back shield 15, from this back feed hopper 20, a fluid is supplied between a processed material rear face and the back shield 11 which counters this, and processing on the rear face of a processed material is performed.

[0034]On the periphery of the back shield 15, the processed material holding mechanism 18 is mostly arranged with the processed material 17 at the position of an equal diameter, and the processed material 17 is held mechanically. What is necessary is just to define it with a mechanical method separately in consideration of attachment and detachment of a processed material, the shape of a processed material, intensity, etc., since the holding method by the processed material holding mechanism 18 of the processed material 17 is not involved in this invention. For example, the processed material attaching part 24 is formed in four places of the

surface periphery of the disk part 23 as a connecting part like drawing 2, and it is sufficient if the periphery edge of the processed material 17 is held from a lower part by this processed material attaching part 24.

[0035]The disk part 23 which the processed material holding mechanism 18 protrudes the processed material attaching part 24 other than said processed material attaching part 24 on a periphery, and has the hole 26 in the center, It is connected in the center of a rear face of the disk part 23, comprises the motor 14 connected to said hole 26, the tubed axis of rotation 25 open for free passage, and the axis of rotation 25, and is provided by the motor 14, enabling free rotation. The disk part 41 of the back shield 15 is arranged by non-contact on the disk part 23 of the processed material holding mechanism 18. The back feed hopper 20 of the back shield 15 is taken out from the inside of the tubed axis of rotation 25 of the processed material holding mechanism 18 according to non-contact on the same axle. Therefore, in the back shield 15 not rotating, the processed material holding mechanism 18 is arranged non-contact, and attains rotation of only the processed material 17 by the motor 14.

[0036]As shown, for example in drawing 3, the processed material holding mechanism 18 is good also as a structure mechanically connected with the inner hood 16. There is no necessity for the 25 axis of rotation of being one, and it may be made to have the axis of rotation 31. What is necessary is to be non rotation until the axis of rotation 25 and the inner hood 16 do $theta_1$** rotation of the axis of rotation 40, and just to make it both the axis of rotation 25, the inner hood 16, and the axis of rotation 40 rotate it, although the axis of rotation 25 and the inner hood 16 do $theta_1$** (abbreviated 90 degree) rotation of, when it becomes more than $theta_1$**. Therefore, while the axis of rotation 25 and the inner hood 16 rotate to $theta_1$**, the processed material holding mechanism 18 carries out $theta_2$** rotation, and twists. What is necessary is just to define the size of $theta_2$** with the gear ratio by the side of the inner hood 16, the axis of rotation 40, and the processed material holding mechanism 18. in this way -- the processed material holding mechanism 18 -- twisting -- the attachment and detachment to the processed material holding mechanism 18 of the tabular processed material 17 are enabled.

[0037]The hood 27 of an abbreviated annular solid is formed in the periphery of the processed material holding mechanism 18 in hollow. It is attached to said processed material holding mechanism 18 in one, and rotates together with the processed material holding mechanism 18, The fluid after the processing discharged with the centrifugal force from between the front shield 11 and the back shields 15 by rotation of the processed material holding mechanism 18 by the method of the outside of a diameter direction, It accepts from the upper part entrance 28 of the hood 27 which faces the crevice between the front shield 11 and the back shield 15, and the direction is bent gently, and it guides caudad, and discharges from the lower part outlet 29 of the hood 27.

[0038]Said hood 27 shifts an interval to a diameter direction, and it assembles the outside hood 12 and the inner hood 16. in a sectional view, the upper part of the outside hood 12 is gently bent from the lower part which carried out linear shape to the method of the inside of a diameter direction -- the collar of the front shield 11 -- it enters into the ** hood receiving part 22 bottom, and is pushed in to this side of the tapered surface 21. Therefore, although the path of the upper bed of the outside hood 12 is smaller than the outside diameter size of the front shield 11, it is larger than the diameter of attachment of the attaching part 24 on the processed material holding mechanism 18. Thus, it is for having made the diameter of an upper bed of the outside hood 12 smaller than the outside diameter size of the front shield 11 catching a processed fluid in the hood 27 effectively, and is because there is a possibility that a fluid may leak from the crevice between the front shields 11 when it is made larger than the outside diameter size of the front shield 11. The diameter of an upper bed of the outside hood 12 was made larger than the diameter of attachment of the attaching part 24 in order not to invade the treatment area of a processed material side, and it is because there is a possibility of the fluid before processing flowing into the hood 27, and interfering with processing of the trailer of the processed material 17 when it is made smaller than the diameter of attachment of the attaching

part 24.
[0039]Even if a fluid falls with the inner hood 16 arranged in the form where it was similar inside the outside hood 12, it is incorporated into the hood 27 with a centrifugal force.
[0040]The lower part outlet 29 of the hood 27 formed in both the lower ends of the outside hood 12 and the inner hood 16 is inserted into the annular recovery cylinder 13 by non-contact, is caught with the hood 27 and can collect now the fluids whose inside of the hood 27 processes [gravity or / which carries out suction fall].
[0041]It is discharged from the periphery of the processed material 17, the fluid supplied from a table and the feed hoppers 19 and 20 located in the central part of the back shields 11 and 15 processing the surface of the processed material 17, and a rear face. From the outside hood 12, the discharged fluid is bent caudad or is **** used as the surface of the inner hood 16 by gravity and suction. Since the inner hood 16 is rotating with the processed material holding mechanism 18, a centrifugal force works in the discharged fluid and the flow to the axis-of-rotation 25 direction of the processed material holding mechanism 18 thru/or the inner hood 16 is suppressed. For this reason, the discharged fluids are collected certainly to the recovery cylinder 13, without flowing backwards on the way.
[0042]It may separate from the processed material holding mechanism 18, and the abbreviated annular solid hood 27 may be non rotation.
[0043]The recovery cylinder 13 is non-contact in the inner hood 16 rotated as it is immobilization and being mentioned already in the meaning which is not rotated. In order to raise recovering efficiency more, connect with the inner hood 16 and make it better [to rotate preferably, although the outside hood 12 may be immobilization in the meaning which is not rotated]. The outside hood 12 is also held the recovery cylinder 13 and non-contact. Since the back shield 15 does not rotate, adherence (rigid) may be satisfactory for the terminal area 30 of the feed hopper 20 established in the back shield 15, and the fluid supply pipe 22 which is stationary systems, therefore it does not generate friction powder in the terminal area 30, and does not leak. Friction powder is not generated, but as long as it does not leak, it may connect by methods other than rigid combination. It can collect certainly to the recovery cylinder 13, without leaking the fluid discharged from between a table and the reverse side shields 11 and 15 by centrifugal-force operation of the outside hood 12 and the inner hood 16.
[0044]next, it is the same as that of drawing 1 -- high -- other embodiments of the pure fluid processing method are shown in drawing 4. In drawing 1, if it removes that the processed material holding mechanism 38 and the inner hood 36 which were one are separated, and it could be made to carry out the roll control independently, it is the same as the embodiment of drawing 1. The processed material holding mechanism 38 and the inner hood 36 comprise a different body, have the axes of rotation 39 and 37 on the same axle, are connected to the motors 32 and 31, respectively, and have been made to carry out independent rotation.
[0045]Originally, it differs from the purpose of rotating the processed material holding mechanism 38, and the purpose of rotating the inner hood 36. It is for the former carrying out fluid processing of the processed material surface uniformly, and is for the latter's making a centrifugal force act on the fluid discharged from between a table and the reverse side shields 11 and 15, and suppressing the axis of rotation 39 of the processed material holding mechanism 38 or the inner hood 36, and the flow to 37 directions. Therefore, rather than the processed material holding mechanism 38, the torque of the inner hood 36 is small and it is sufficient for it. Torque is large, and if a big centrifugal force is added, it will be necessary to raise intensity. Since the torque of the inner hood 36 can be dropped on this point rather than the processed material holding mechanism 38, it also becomes possible to use a cheap plastic for the construction material of the inner hood 36 which is united with the inner hood 36 and this. It is possible to raise the torque of the processed material holding mechanism 18 conversely, to earn a centrifugal force further, and to also make performance raise. Anyway, since the rotation doubled with the user's purpose can be chosen, it is also possible to make it not rotate the inner hood 36, and user-friendliness's of a user improves. The two axes of rotation 37 and 39 may be rotated by gear transfer by one motor.
[0046]By the embodiment of drawing 1 mentioned above - drawing 4, the processed material

holding mechanism 18 thru/or the processed material 17 all rotated, and the case where the front shield 11 and the back shield 15 were being fixed was explained. However, this invention can be applied when the processed material 17, and a table and reverse side shields 11 and 15 are rotating relatively. As [both] an example of relative rotation, when processed material holding mechanism, and a table and a reverse side shield other than the above-mentioned embodiment rotate, processed material holding mechanism is immobilization and a table and a reverse side shield may rotate. Here, an embodiment in case the processed material holding mechanism 83 is the latter which a table and the reverse side shields 81 and 82 rotate by immobilization is explained using drawing 5.

[0047]What is shown in drawing 5 is fundamentally the same as the embodiment of drawing 4, if the point which is fixed without a table and the reverse side shields 81 and 82 fixing not but rotating, and the processed material holding mechanism 83 rotating is removed. That is, a motor is removed from the processed material holding mechanism 83, and processed material holding mechanism 83 is considered as immobilization. The motors 84 and 85 are attached to a table and the reverse side shields 81 and 82, respectively, and coaxial rotation of a table and the reverse side shields 81 and 82 is enabled at them. Since it was made to rotate a table and the reverse side shields 81 and 82 here, each terminal area of the feed hoppers 19 and 20 established in the rear surface shields 81 and 82 used as a rotation system and the feed pipes 89 and 90 used as a stationary system becomes a problem. If it connects so that a fluid may not leak to the feed hoppers 19 and 20 as mentioned already, a terminal area will rub. It is because a fluid will leak from a terminal area if it connects so that it may not rub. However, friction powder can be effectively prevented from reducing fricative generating and mixing in a fluid by using the bearings 86 and 87 with little friction to a terminal area. The magnetofluid bearing using magnetofluid for example as the bearings 86 and 87 with little friction, The magnetic bearing which buried the fluid film bearing and the feed pipes 89 and 90 using liquid film magnetically, and buried the crevice by magnetofluid thru/or liquid film with surfacing ****, The hydrodynamic bearing which furthermore supports a movement body with the kinetic pressure of a fluid, the hydrostatic bearing which supports a movement body with the static pressure of a fluid, There are a highly precise static pressure air bearing, a compounded type magnetic bearing (structure combined with the permanent magnet of a drawn-in type or repulsion type and at least 1 set of active form (electromagnet current is controlled) magnetic bearings), etc. also in hydrostatic bearing.

[0048]Although the number of motors increases compared with the thing of drawing 4, since a powerful centrifugal force acts on the fluid supplied since the table and the reverse side shields 81 and 82 which have sandwiched the processed material 17 rotate by both sides of the processed material 17, the homogeneity of the fluid processing on the surface of a processed material improves, and the discharge effect of a processed fluid is also large.

[0049]The fluid processor which carries out fluid processing to the cheap fluid processing method of this invention high clarification and cheaply next is explained using drawing 6.

[0050]The principal part of the fluid processor used the thing of drawing 1. The fluid processing cistern 116 can supply fluid processing liquid now to the front feed pipe 117 via the pump 109 and the valve 108. Treating fluid, such as ultrapure water, can be supplied now for inactive gas other than said fluid processing liquid to said table feed pipe 117 via the valve 106 via the valve 102.

[0051]It is connected to the eliminator 112 via the piping 121, and the account 112 of separation passes along the filter 113 through the cold energy machine 115 from the pump 114, and is connected to the back feed pipe 104 via the valve 110, and the recovery cylinder 103 constitutes the circulatory system 120 of the fluid collected by these. And said table feed pipe 117 is connected with the back feed pipe 104 via the valve 111.

[0052]Now, the fluid processing method of the processed material using a fluid processor with the above-mentioned system is explained.

[0053]The valves 108 and 110 are opened first, the valve 111 is closed, fluid processing liquid is pumped up with the pump 109 from the fluid processing cistern 116, and fluid processing liquid is supplied to the processed material 107 from the front shield 101. It is discharged from the end

face of the processed material 107, fluid processing liquid processing the surface of the processed material 107, is caught with the hood 119, and is collected by the recovery cylinder 103. The suction exhaust air of the separator 112 is always carried out, and in outside, the fluid processing liquid of the recovery cylinder 103 is attracted with the open air which enters from the crevice between the inner hoods 117 and 118 and the recovery cylinder 103, and is introduced into the separator 112. The bottom of the separator 112 is covered with fluid processing liquid with the vortex and gravity which are automatically generated within the separator 112. If the separator 112 is filled with fluid processing liquid, it is automatically discharged with the open air. It is collected by the recovery cylinder 103, fluid processing liquid collected on the bottom of the separator 112 letting the pump 114, the cold energy machine 115, and the filter 113 pass, being supplied to the back shield 105 through the back feed pipe 104, and carrying out fluid processing of the rear face of the processed material 107.

[0054]The rear face is remarkably polluted by conveyance of a processed material, maintenance, etc. from the surface many of processed materials 107. Therefore, although the surface cannot be processed using the fluid which processed the rear face, even if it processes a rear face using the fluid which processed the surface, it does not interfere at all. The fluid which processed the rear face is always mixed with the recovery cylinder 103 with the fluid which processed the surface. Therefore, even if freshness is held mostly and the collected fluid circulates this, a pollutant is not accumulated in the fluid supplied to the back shield 105.

[0055]The circulating flowing quantity of the fluid which is for said separator 112 built into the circulatory system 120 discharging automatically a fluid excessive when circulating a fluid to the back shield 105, and circulates through the circulatory system 120 by this will be regulated automatically. As long as it is not necessary to carry out automatic discharge of the excessive fluid, this separator 112 may be unnecessary, as long as it only separates a gas and a fluid, it may be sufficient, and the vapor-liquid-separation machine using reverse osmosis, a hollow system method, etc. may be used. The cold energy machine 115 is not needed in particular, if it is not necessary to control the temperature of fluid processing liquid precisely. It does not need, especially if the filter 113 also has small contamination of the processed material 107. It is adding the fluid which processed the surface of the processed material 107, and what is necessary is in short, just to be able to exhibit the circulation-of-fluid function for processing of a rear face in the fluid which processed and collected the rear faces of the processed material 107.

[0056]Therefore, the valve 110 is made close, a fluid is supplied from the fluid processing cistern 116 to both the front shield 101 and the back shield 105 by making the valves 108 and 111 open, these is collected, and it discharges from the separator 112. It becomes possible to manage the fluid amount of consumption below half as compared with the conventional thing, and moreover friction powder does not mix, but a high clarification and cheap fluid processing method can be realized. To drawing 6, it may return to the fluid processing cistern 116, and the fluid discharged from the separator 112 although not illustrated may be reused, if it does not interfere.

[0057]Although this invention was described as an example of application to washing of a silicon wafer, if it is the fluid processing of a tabular processed material, it will not be limited to this. For example, if each component is chosen so that current can be sent through a front shield, a back shield, and a tabular processed material, it can use also for electrolytic deposition.

[0058]

[Example]In <Example 1> this example, it carried out using the following material, parts, a processed material, a fluid, fluid processing operation, and evaluation.

(1) The - recovery cylinder 103 made from a material and table shield 101, product made from high grade glassy carbon and with a back shield 105:thickness of 20 mm outside hood 117, and inner hood 118:high grade silicon carbide system : polytetrafluoroethylene (PTFE is called henceforth)

(2) Part and separator 112:. The cyclone pump 109 made from PTFE 5 cm in diameter, 114:. Iwaki bellows-pump FA-2E and cold energy machine 115:. CS made from top TSUEREKURONIKUSU -- heater AIH-33 and all the Teflon filter valves 102, 106, 108, and 110 by filter 113:Nihon Millipore, and 116:20 l. of product air operated valve SAVmade from

111:advance-3240 and fluid processing cisterns (I). PTFE tub (3) processed material and a processed material are 8-inch wafers, and is a product made from the Shin-etsu chemicals of diameter:200mm and thickness:0.725-mm resistivity:6.01 - 12.0-ohmcm.
[0059]this wafer -- particle diameter: -- 50% fluoride hydro acid: which added about 0.2 micrometer of silicon powder -- it was immersed in the fluorine aqueous solution of water =1:99, and about 6000 silicon powder was made to adhere to it for 15 minutes in a wafer surface It asked for cleaning performance from the extraction ratio of this silicon powder.
(4) a fluid and fluid processing liquid -- 28% ammonia solution: -- 30% hydrogen-peroxide-solution: -- the solution of water =1:2:7. Temperature: 80 **.
- Inactive gas : the nitrogen (5) fluid-processor table cover version 101 of the room temperature was pulled up, the processed material 107 was made to hold and the front shield 101 was pulled up.
[0060]The processed material 107 was rotated at 500 rpm. The valves 108 and 110 were made open, the valves 102, 106, and 111 were made close, and said fluid was supplied to the front shield 101 by the flow of 1.5 l. / min with the pump 109 from the fluid processing cistern 116. Subsequently, the cyclone separator 112 separated and recovered the fluid which processed the surface of the processed material 107, and circulation feed was carried out by the flow of 1.5 l. / min to the back shield 105 through the cold energy machine 115 and the filter 113 with the pump 114.
[0061]After performing this fluid processing for 3 minutes, the pumps 109 and 114 were suspended, the valves 108 and 110 were closed, the valves 106 and 111 were opened, ultrapure water was supplied to the front shield 101 and the back shield 105, and the fluid was rinsed for 30 seconds. Subsequently, the valve 106 was closed, made the valve 102 open, and nitrogen gas was supplied to the front shield 101 and the back shield 105, and rotation of the processed material 107 was 1000 rpm.
[0062]After performing this for 90 seconds, the valve 102 was made close, the front shield 101 was pulled up, and the wafer of the processed material 107 was taken out.
(6) as a result of measuring the number of adhesion after the extraction ratio evaluation above-mentioned fluid processing of silicon powder using the laser Hitachi Electronics Engineering surface inspection apparatus, it is below ten piece / wafer -- very -- a short time -- high -- it turned out [pure] that was done for fluid processing.
<Example 2> The used material, parts, a fluid, fluid processing operation, and evaluation are the same as <Example 1> except being shown below.
(1) Material - back shield 105 : the same wafer as the 20-mm-thick processed material made from polytetrafluoroethylene (2) <Example 1> was used. this wafer -- 28% ammonia solution: -- 30% hydrogen-peroxide-solution: -- it processed for 10 minutes at 80 ** among the solution of water =1:2:7. Subsequently, 50% hydrofluoric acid: For 2 minutes, the fluoric acid solution of water =1:99 was made to immerse, and the natural oxidation film of the wafer surface was removed in it. The wafer which was immersed in the solution which diluted the reference solution for the atomic analyses analysis of nickel, and was cm^{-2}[an about 10^{12} atom /]-polluted with the metal ion of nickel for 30 minutes in it was created after rinsing.
(3) 36% of fluid hydrochloric-acid-water: -- 20% hydrogen-peroxide-solution: -- although the solution of water =1:1:5 and a temperature:80 **(4) fluid-processing operation operating procedure are the same as <Example 1>, the fluid processing time in this example is 90 seconds.
(5) the number of adhesion of the metal ion after the evaluation above-mentioned processing of the extraction ratio of a metal ion -- total-internal-reflection X-ray fluorescence device [made from a technos]: -- it measured using TREX610, a $6x10^{9}$ atom / cm^{2} was obtained, and it turned out that fluid processing was carried out to quickness and high clarification.
<Example 3> The used material, parts, a processed material, a fluid, fluid processing operation, and evaluation are the same as <Example 1> except being shown below.
(1) Part cold energy machine 115 : product made from the Komatsu electronics Chemical circulator NE-33C-7 (2) The same wafer as a processed material <Example 1> was used. Polysilicon with a level difference was attached to this wafer surface.

(3) 50% of fluid hydrofluoric acid : solution of water =1:99. Temperature: Room temperature.
(4) Although the fluid processing operation operating procedure is the same as that of <Example 1>, the fluid processing time in this example is 90 seconds.
(5) The dry stain generated when drying the evaluation wafer of a water mark is called water mark. Oxygen in the air dissolves in the waterdrop adhering to a wafer, and a main generation cause oxidizes and dissolves the silicon of a wafer, and when a melted object remains as a drying residual, it produces it.
[0063]This watermark is a size 1-10 micrometers in diameter, and was measured using the Hitachi electron microscope S-7100.
[0064]as a result -- comparing with about eight-piece [/cm] ^{2} of the batch method which is 0-2-piece [/cm] ^{2}, and is the present mainstream fluid processing method -- high -- it turned out that it is the pure fluid processing method.
[0065]
[Effect of the Invention]cheap by according to this invention method, collecting, circulating through the fluid which carried out fluid processing of the processed material surface, and supplying it also to a processed material rear face -- high -- pure fluid processing is realizable.
[0066]moreover -- without it generates friction powder for supply of the fluid to a table and a reverse side shield by considering a table and a reverse side shield as immobilization, and rotating only a processed material according to this invention device -- high -- pure fluid processing is realizable.
[0067]While rotating only processed material holding mechanism to a table and a reverse side shield furthermore according to this invention device, With an easy structure of establishing the circulatory system which dilutes the fluid which performed rear-face processing with the fluid which performed the surface treatment, and makes a processed material rear face circulating through it, the high clarification and cheap fluid processing of a described method is realizable.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a lineblock diagram of the fluid processor by an embodiment.
[Drawing 2]It is the perspective view which expanded the important section of the processed material attaching part.
[Drawing 3]It is a lineblock diagram of the modification of an embodiment.
[Drawing 4]It is a lineblock diagram of the fluid processor by other embodiments.
[Drawing 5]It is a lineblock diagram of the fluid processor by other embodiments.
[Drawing 6]It is a piping distribution diagram showing circulation of the fluid processor by an embodiment and a fluid.
[Drawing 7]It is a lineblock diagram showing the 1st conventional example.
[Drawing 8]It is the composition which shows the 2nd conventional example.
[Description of Notations]
11 Front shield
12 Outside hood
13 Recovery cylinder
14 Motor
15 Back shield
16 Inner hood
17 Processed material
18 Processed material holding mechanism
19 Feed hopper
20 Feed hopper
22 Feed pipe

[Translation done.]

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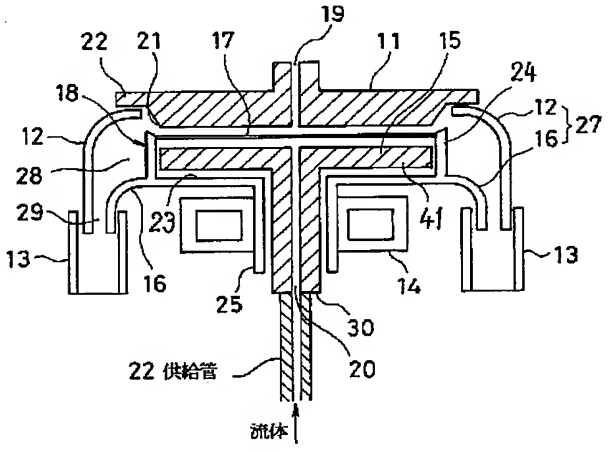
最終頁に続く

(54)【発明の名称】　被処理物の流体処理方法及びその装置

(57)【要約】
【課題】　摩擦粉を発生せず、流体を漏らすことがなく、被処理物表面とともに被処理物裏面を高清浄かつ安価に流体処理する。
【解決手段】　被処理物１７を保持する被処理物保持手段１８と、乱流で被処理物裏面が汚染されるのを防ぐ裏遮蔽板１５とを機械的に分離する。裏遮蔽板１５を表遮蔽板１１と同様に固定し、被処理物保持手段１８のみを回転させて、裏遮蔽板１５を介して流体を供給する供給管２２を裏遮蔽板１５にリジッドに接続できるようにする。また、被処理物表面を流体処理した流体を回収筒１３で回収し、これを循環して供給管２２より被処理物裏面に供給する循環系を設ける。



【特許請求の範囲】

【請求項１】被処理物の表裏面が汚染されるのを防ぐために前記被処理物の表裏面を表遮蔽板および裏遮蔽板で覆い、前記表遮蔽板および裏遮蔽板に対して被処理物を相対的に回転させて、

前記被処理物の表面と前記表遮蔽板との間に流体を供給して、前記被処理物の表面の流体処理を実行し、

前記被処理物表面の流体処理を実行した処理済みの流体を回収し、

この回収した被処理物表面の処理済みの流体を前記被処理物の裏面と前記裏遮蔽板との間に供給して、前記被処理物の裏面の流体処理を実行することを特徴とする被処理物の流体処理方法。

【請求項２】前記被処理物裏面の流体処理を実行した処理済みの流体を回収し、

この回収した被処理物裏面の処理済みの流体をも、前記被処理物の裏面と前記裏遮蔽板との間に供給して、前記被処理物の裏面の流体処理を実行することを特徴とする請求項１に記載の被処理物の流体処理方法。

【請求項３】前記被処理物の外周に流体捕捉用のフードを前記被処理物または前記表遮蔽板および前記裏遮蔽板と同軸回転するように配置し、

前記処理済みの流体を回収するために、前記被処理物または前記表遮蔽板および前記裏遮蔽板とともに前記フードを回転して前記処理済みの流体に遠心力を与え、これにより前記被処理物の径方向外方に排出される処理済みの流体を前記フードで捕捉するようにした請求項１に記載の被処理物の流体処理方法。

【請求項４】前記被処理物裏面の流体処理を実行した処理済み流体に前記被処理物表面の流体処理を実行した処理済み流体を混合して回収するようにしたことを特徴とする請求項１又は２に記載の被処理物の流体処理方法。

【請求項５】前記被処理物に対して行なうべき流体処理に応じて供給する流体を選択して、前記被処理物の表裏面の流体処理を実行することを特徴とする請求項１ないし３のいずれかに記載の被処理物の流体処理方法。

【請求項６】被処理物を保持する被処理物保持手段と、前記被処理物保持手段に保持される被処理物の表面および裏面をそれぞれ遮蔽し、前記被処理物保持手段に対して相対的に回転する表遮蔽板および裏遮蔽板と、

前記表遮蔽板に設けた供給口を通して前記表遮蔽板と前記被処理物表面との間に流体を供給する流体供給系と、

少なくとも被処理物表面の流体処理を実行した処理済み流体を捕捉するフードと、

前記フードで捕捉した前記処理済み流体を前記フードに設けた出口から回収する回収手段と、

前記回収手段によって回収された前記処理済み流体を、前記被処理物裏面の流体処理を実行するために前記裏遮蔽板に設けた供給口を通して前記裏遮蔽板と被処理物裏面との間に供給し、前記被処理物裏面の流体処理を実行した処理済みの流体を前記回収手段に回収する循環系とを備えた被処理物の流体処理装置。

【請求項７】前記フードは、前記被処理物保持手段または前記表遮蔽板および裏遮蔽板と同軸回転するように配置され、前記回転により発生する遠心力を受けて前記被処理物の外周より排出される被処理物表面の流体処理を実行した処理済み流体と被処理物裏面の流体処理を実行した処理済み流体とを捕捉するように構成されている請求項６に記載の被処理物の流体処理方法。

【請求項８】前記被処理物保持手段を回転させ、前記表遮蔽板および裏遮蔽板を固定した請求項６又は７に記載の被処理物の流体処理装置。

【請求項９】前記被処理物保持手段は、前記裏遮蔽板に設けた供給口を内部に設けた中空の回転軸と、前記被処理物の外周に設けられ前記処理物の外周を保持する保持部と、前記回転軸から径方向外方に前記裏遮蔽板の外周近くまで延出されて前記回転軸に前記保持部を連結する連結部とを備えている請求項６ないし８のいずれかに記載の被処理物の流体処理装置。

【請求項１０】前記フードが、被処理物の外周から排出される処理済みの流体の進路の前方を覆う外フードと、前記処理済みの流体の進路の下部を覆う内フードとで構成され、少なくとも内フードが前記被処理物保持手段と同軸で回転するようになっている請求項６ないし９のいずれかに記載の被処理物の流体処理装置。

【請求項１１】前記被処理物保持手段と前記フードとを一体的に構成した請求項６ないし１０のいずれかに記載の被処理物の流体処理装置。

【請求項１２】前記被処理物保持手段と前記フードとを別体化して、それぞれ個別に回転制御できるようにした請求項６ないし１１のいずれかに記載の被処理物の流体処理装置。

【請求項１３】前記循環系に流体の循環流量を調節する手段を備えたことを特徴とする請求項６ないし１２のいずれかに記載の被処理物の流体処理装置。

【請求項１４】前記循環流量を調節する手段が、流体の遠心力を利用したサイクロン分離機であることを特徴とする請求項１３に記載の被処理物の流体処理装置。

【請求項１５】前記表遮蔽板および裏遮蔽板がカーボンもしくはフッ素樹脂で形成されていることを特徴とする請求項６ないし１４のいずれかに記載の被処理物の流体処理装置。

【請求項１６】前記回収手段が固定され、この固定の回収手段に前記フードの下部出口が非接触で挿入されていることを特徴とする請求項６ないし１５のいずれかに記載の被処理物の流体処理装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、薄膜デバイスの製造工程に必要な被処理物の流体処理方法およびその装置

にかかり、特に、高い清浄性が要求される半導体製造工程に好適な、被処理物の流体処理方法およびその装置に関する。

【０００２】

【従来の技術】近年、半導体、液晶ディスプレイ、磁気ディスクなどの薄膜デバイスは構造の微細化が進み、これらのデバイスの性能及び製造の歩留り向上のため、製造工程の高度な清浄性が望まれる。半導体ウェーハの例でいえば、除去すべき異物の大きさは０．２μｍ以上のものがウェーハ１枚当たり１０個以下、金属イオンの汚染量は10^{10}原子／cm^2以下、空気に触れることによって形成される酸化膜の厚さは１ｎｍ以下とすることが要求されている。

【０００３】さらに、多品種混合生産が不可避となり、複数の製造工程に対応できる装置が必要となり、板状被処理物（以下、単に被処理物ということもある）を１枚づつ処理する、枚葉処理方法が実用化されつつある。

【０００４】第１の従来例としては、図７に示す特開平８－３１６９０号公報の基板処理が挙げられる。この従来例は板状被処理物５３を基板保持部材５４に固定すると共に、回転する（回転手段は図示されていない）。板状被処理物５３の回転によって発生する乱流によって被処理物表面が汚染されることを防ぐために遮蔽板（以下、表遮蔽板と称す）５２で板状被処理物５３の表面を覆いながら、純水噴射ノズル５１より処理液が板状被処理物５３の表面にのみ噴射して流体処理される。この第１の従来例では、板状被処理物５３の裏面に遮蔽板（以下、裏遮蔽板と称す）が設置されていないので、次のような欠点があった。

【０００５】裏面が流体処理されていないことに加え、板状被処理物５３の裏面で発生する乱流によって被処理物裏面が汚染される。被処理物裏面が汚染されると、その後の工程で、被処理物裏面と接触する被処理物搬送アーム、被処理物保持具など（図示せず）の表面を転写汚染し、その後の被処理物裏面を一層汚染し、品質を低下させる。特に、熱のかかる工程では被処理物裏面に付着した汚染物が揮発して、被処理物表面に達し、被処理物表面に致命的汚染を生じる。

【０００６】この不具合を解消できる第２の従来例として、図８に示す特開平８－７８３６８号公報のワークの処理方法および装置が挙げられる。この従来例では被処理物の裏面も裏遮断板６２で覆って、前記の乱流による被処理物裏面の汚染を防ぐと共に、被処理物表面と裏面を同時に流体処理している。

【０００７】ところで、被処理物表面を均一に流体処理するには被処理物６４を回転させることが必須である。この点で、この第２の従来例では、裏遮蔽板６２に被処理物６４の保持具を機械的に一体に設け、被処理物６４と裏遮蔽板６２とを同時にモータ６５で回転させている。流体は、供給タンク７４より三方弁６７、６８を切り換えて表遮蔽板６１と裏遮蔽板６２に分岐供給している。ここで第２の従来例には裏遮蔽板６２への供給管７６の接続構造については明記されていないが、一方の裏遮蔽板６２は回転しており、他方の供給管７６は一般的には固定である。なお、符号７０は新液供給部である。

【０００８】

【発明が解決しようとする課題】しかし上述した第２の従来例には、次のような問題点があった。

【０００９】まず、裏面を処理した流体は汚染されているので固定フード６３に回収しても再利用できない。このため三方弁６９を切り換えて、固定フード６３に回収された流体を廃棄せざるを得ない。しかし廃棄すれば多量の流体を消費する。なお、図８の系統図では一見、裏面を処理した流体を循環利用しているように見えるが、裏面を処理した流体は汚染が大きいため、たとえフィルタ７２、７５で濾過しても循環利用することはできない。

【００１０】つぎに、流体を供給する固定の供給管７６を、回転する裏遮蔽板６２に設けた供給口に流体が漏れることがないように接続すれば、接続部が摩擦する。摩擦粉が流体に混入して流体を汚染し、固定フード６３、回収タンク７１、ポンプ７３、供給タンク７４を通して表遮蔽板６１に達し、被処理物裏面はもとより、被処理物表面を汚染して品質を致命的に低下させる。

【００１１】かといって、流体を供給する固定の供給管７６と回転する裏遮蔽板６２を、互いに摩擦しないように接続すれば、接続部より流体が漏れ、多くの場合流体中に含まれる腐食性物質によって、モータ６５などの部品を腐食する。

【００１２】このように、均一処理のため被処理物の回転を要する枚葉処理においては、未だ被処理物を高清浄に流体処理する方法と装置が実現されていなかった。

【００１３】本発明の課題は、上記従来技術の問題点を解決することにあり、第１の課題は流体を循環使用して安価で高清浄に流体処理することが可能な被処理物の流体処理方法を提供することにある。第２の課題は被処理物表面とともに被処理物裏面を高清浄に流体処理することが可能な被処理物の流体処理装置を提供することにある。第３の課題は摩擦粉を発生せず、流体を漏らすことがなく、高清浄な被処理物を得ることが可能な被処理物の流体処理装置を提供することにある。

【００１４】

【課題を解決するための手段】第１の方法発明は、被処理物の表裏面が汚染されるのを防ぐために前記被処理物の表裏面を表遮蔽板および裏遮蔽板で覆い、前記表遮蔽板および裏遮蔽板に対して被処理物を相対的に回転させて、前記被処理物の表面と前記表遮蔽板との間に流体を供給して、前記被処理物の表面の流体処理を実行し、前記被処理物表面の流体処理を実行した処理済みの流体を回収し、この回収した被処理物表面の処理済みの流体を

前記被処理物の裏面と前記裏遮蔽板との間に供給して、前記被処理物の裏面の流体処理を実行することを特徴とする被処理物の流体処理方法である。

【００１５】被処理物は半導体ウェーハ、液晶表示装置用のガラス、磁気ディスクなどの板状基板である。被処理物保持手段は、回転によって発生する遠心力に抗して被処理物を保持できるものであることを要する。

【００１６】第１の発明では、被処理物表面の処理を実行した流体を回収し、これを被処理物裏面に循環供給して被処理物裏面の処理を実行している。被処理物表面の処理を実行した流体を回収して、再度被処理物表面の処理を実行することはできないが、被処理物表面と比べて汚染度の大きい被処理物裏面の場合には、被処理物表面の処理を実行した流体を使って流体処理を実行しても何ら支障はない。被処理物表面の処理を実行した流体を使用して被処理物裏面の処理を実行するので、流体の使用量を低減でき、安価な流体処理が実現できる。

【００１７】特に、回転するのはフードを除いて被処理物保持手段だけで、表遮蔽板および裏遮蔽板は回転しないようにすると、表遮蔽板に設けた供給口と流体供給系、および裏遮蔽板に設けた供給口と循環系とは摩擦粉を発生させず、漏れのない状態で裏遮蔽板に設けた供給口と循環系とを容易に接続することができる。したがって、より清浄で安価な流体処理が実現できる。

【００１８】第１の発明において、前記被処理物裏面の流体処理を実行した処理済みの流体を回収し、この回収した被処理物裏面の処理済みの流体をも、前記被処理物の裏面と前記裏遮蔽板との間に供給して、前記被処理物の裏面の流体処理を実行することが好ましい。被処理物裏面の処理を実行した流体を循環させて被処理物裏面の処理を実行するので、流体の使用量を一層低減でき、より安価な流体処理が実現できる。

【００１９】また、第１の発明において、前記流体処理を実行して被処理物の外周に排出される流体を捕捉するフードを前記被処理物保持手段または表遮蔽板および裏遮蔽板と同軸回転させるように配置し、前記フードの回転により、前記流体処理を実行して排出される処理済みの流体に、前記回転する被処理物保持手段または表遮蔽板および裏遮蔽板とともに遠心力を与え、これにより径方向外方に排出される処理済みの流体を前記フードで捕捉して回収するようにしてもよい。フードは被処理物保持手段または表遮蔽板および裏遮蔽板と共に回転しているので、排出された処理済み流体には遠心力が働き、被処理物保持手段または表遮蔽板および裏遮蔽板の回転軸方向への流れを抑える。このため排出された処理済み流体は回転軸方向から漏れ出すことなく、回収手段へ有効に回収される。このように、フードを回転させて被処理物保持手段または表遮蔽板および裏遮蔽板とともに排出流体に遠心力を与えて、回転軸方向への流れを抑えるようにしたので、流体を有効に回収できて安価な流体処理が実現できる。

【００２０】また、上記第１発明において、前記被処理物裏面の処理を実行した流体に前記被処理物表面の処理を実行した流体を混合して回収し、この回収した流体を前記被処理物裏面に循環供給して前記被処理物裏面の処理を実行するようにしてもよい。これによれば、被処理物裏面の処理を実行した流体を、被処理物表面の処理を実行した流体に混合して回収することで、被処理物裏面の処理を実行した流体の汚れを希釈化するようにしたので、回収した流体を被処理物裏面に循環させることで被処理物裏面の処理を実行できるようになり、一層経済的な流体処理を実現できる。

【００２１】さらに、前記被処理物に対して行なうべき処理に応じて供給する流体を選択して、前記被処理物の表裏面の処理を実行するようにしてもよい。被処理物に対して行うべき処理としては、洗浄処理を例にあげれば、洗浄、リンス、乾燥の３工程で１セットとなる。この場合、洗浄には所定割合のアンモニア＋過酸化水素水＋水や、フッ化水素酸＋水などの洗浄液、リンスには超純水、乾燥にはアルゴンやN_2ガスなどの不活性ガスを使用する。これによれば、処理に応じて供給する流体を選択して、被処理物の表裏面の処理を実行するようにしたので、プロセスの共通化が図れ、流体処理効率が一層向上する。

【００２２】第２の装置発明は、被処理物を保持する被処理物保持手段と、前記被処理物保持手段に保持される被処理物の表面および裏面をそれぞれ遮蔽し、前記被処理物保持手段に対して相対的に回転する表遮蔽板および裏遮蔽板と、前記表遮蔽板に設けた供給口を通して前記表遮蔽板と前記被処理物表面との間に流体を供給する流体供給系と、少なくとも被処理物表面の流体処理を実行した処理済み流体を捕捉するフードと、前記フードで捕捉した前記処理済み流体を前記フードに設けた出口から回収する回収手段と、前記回収手段によって回収された前記処理済み流体を、前記被処理物裏面の流体処理を実行するために前記裏遮蔽板に設けた供給口を通して前記裏遮蔽板と被処理物裏面との間に供給し、前記被処理物裏面の流体処理を実行した処理済みの流体を前記回収手段に回収する循環系とを備えたことを特徴とする被処理物の流体処理装置である。

【００２３】循環系から裏遮蔽板に設けた供給口に流体を供給すると被処理物裏面の処理が実行される。被処理物の表裏面の処理を実行した処理済みの流体はフードで捕捉されて回収手段に回収されて混合される。このとき、被処理物裏面の処理を実行することで大きく汚染された流体は、被処理物の表面の処理を実行することで比較的小さな汚染に止められた流体によって希釈されるため、汚染度が低下する。したがってこの汚染度の低下した混合流体を被処理物裏面に循環させることによって被処理物裏面の処理を実行しても流体処理に何ら支障は生

じない。

【００２４】第２の発明において、前記フードを、前記被処理物保持手段または前記表遮蔽板および裏遮蔽板と同軸回転するように配置され、前記回転により発生する遠心力を受けて前記被処理物の外周より排出される被処理物表面の流体処理を実行した処理済み流体と被処理物裏面の流体処理を実行した処理済み流体とを捕捉するフードとすることが好ましい。

【００２５】また被処理物保持手段に対して、表遮蔽板および裏遮蔽板を固定にすると、これらの供給口に対する固定系流体供給管の接続は、接続部で摩擦粉が発生せず、流体を漏らさない固定方法を採用できる。共に固定した表遮蔽板および裏遮蔽板に設けた供給口に対して固定系流体供給管から流体を供給するので、被処理物保持手段と機械的に一体となって回転する裏遮蔽板に設けた供給口に対して流体を供給する場合と比べて、供給口と流体共供給管との接続部で摩擦粉を発生させず、流体を漏らさないように接続することができる。したがって摩擦粉の混じらない高清浄な流体処理を実現できると共に、流体の漏れにより流体中に含まれる腐食性物質で回転駆動源などの部品が腐食するのを防止できる。

【００２６】被処理物保持手段を固定し、表遮蔽板及び裏遮蔽板を回転させる場合は、摩擦の少ない軸受を使用して、接続部で極力摩擦が生じないようにする。

【００２７】第２の発明において、前記被処理物保持手段を回転させるようにした場合、その被処理物保持手段は、前記裏遮蔽板に設けた供給口を内部に設けた中空の回転軸と、前記被処理物の外周に設けられ前記処理物の外周を保持する保持部と、前記回転軸から径方向外方に前記裏遮蔽板の外周近くまで延出されて前記回転軸に前記保持部を連結する連結部とから構成してもよい。また、前記フードが、被処理物の外周から排出される流体の進路を覆う外フードと、前記流体の進路の下部を覆う内フードとで構成され、少なくとも内フードが前記被処理物保持手段と同軸で回転するようにしてもよい。

【００２８】また、回転する被処理物保持手段と前記フードとを一体的に構成してもよく、また前記被処理物保持手段と前記フードとを別体化して、それぞれ個別に回転制御できるようにしてもよい。また、前記循環系に流体の循環流量を調節する手段を備えるようにすることもでき、この場合循環流量を調節する手段を、流体の遠心力を利用したサイクロン分離機で構成してもよい。

【００２９】なお、前記表遮蔽板および裏遮蔽板がカーボンもしくはフッ素樹脂であることが好ましい。また、前記回収手段が固定され、この固定の回収手段に前記フードの出口が非接触でに挿入されていることが好ましい。

【００３０】

【発明の実施の形態】以下に本発明の実施の形態を図面を用いて説明する。表、裏遮蔽板が固定され、被処理物が保持されつつ回転し、流体が回収される方法について図１を用いて説明する。

【００３１】表遮蔽板１１と裏遮蔽板１５は回転しない意味で固定されている（固定方法は図示していない）。表遮蔽板１１は被処理物１７を保持するときは引上げられるようになっている。表遮蔽板１１と裏遮蔽板１５は被処理物１７に対向する面で、被処理物１７に接触することなく略平行に配置される。被処理物１７と表遮蔽板１１および裏遮蔽板１５との距離は、流体の種類と流体処理の目的に応じて定めればよい。

【００３２】前記表遮蔽板１１は板状被処理物１７よりも径がやや大きい円盤状をしており、板状被処理物１７の表面を覆うことにより、板状被処理物１７の回転によって発生する乱流で被処理物表面が汚染されるのを防ぐようになっている。表遮蔽板１１の中央に表供給口１９を突設し、この表供給口１９から、被処理物表面とこれに対向する表遮蔽板１１との間に流体を供給し、被処理物表面の処理を実行するようになっている。表遮蔽板１１の外周には、断面図に見られるように、裏面側から表面側外方に向かってテーパ面２１が形成され、テーパ面２１の終わりには表遮蔽板１１の全厚よりも薄い鍔状の外フード受部２２が形成されている。

【００３３】前記裏遮蔽板１５は板状被処理物１７よりも径がやや小さな円盤状をしており、板状被処理物１７の裏面を覆うことにより、板状被処理物１７の回転によって発生する乱流で被処理物裏面が汚染されるのを防ぐようになっている。裏遮蔽板１５の中央に、前記表供給口１９よりも長い裏供給口２０を突設し、この裏供給口２０から、被処理物裏面とこれに対向する裏遮蔽板１１との間に流体を供給し、被処理物裏面の処理を実行するようになっている。

【００３４】裏遮蔽板１５の外周には、被処理物１７とほぼ同径の位置に被処理物保持手段１８が配置され、被処理物１７を機械的に保持するようになっている。被処理物１７の被処理物保持手段１８による保持方法は、本発明に係わらないので別途、被処理物の着脱、被処理物の形状、強度などを考慮して機械的方法で定めればよい。例えば、図２のように連結部としての円板部２３の表面外周の４箇所に被処理物保持部２４を設けて、この被処理物保持部２４で被処理物１７の外周縁を下方から保持すれば足りる。

【００３５】被処理物保持手段１８は、前記被処理物保持部２４の他に、被処理物保持部２４を外周に突設し中央に穴２６を有する円板部２３と、円板部２３の裏面中央に連結されて前記穴２６と連通する筒状の回転軸２５と、回転軸２５に結ばれたモータ１４にて構成されて、モータ１４により回転自在に設けられる。裏遮蔽板１５の円盤部４１は、被処理物保持手段１８の円板部２３上に非接触で配置される。被処理物保持手段１８の筒状回転軸２５の内部から裏遮蔽板１５の裏供給口２０が同軸

で非接触で取り出される。したがって、被処理物保持手段１８は、回転しない裏遮蔽板１５とは非接触に配置され、モータ１４により被処理物１７のみの回転を達成する。

【００３６】更には、例えば図３に示すように、被処理物保持手段１８は内フード１６と機械的に接続した構造としてもよい。回転軸２５は１つである必要性はなく、回転軸３１を持つようにしてもよい。回転軸２５、内フード１６がθ_1°（略９０°）回転するが、回転軸４０は回転軸２５、内フード１６がθ_1°回転するまで非回転であり、θ_1°以上になると回転軸２５、内フード１６、回転軸４０が共に回転するようにすればよい。よって、回転軸２５、内フード１６がθ_1°まで回転する間、被処理物保持手段１８がθ_2°回転し、振られる。θ_2°の大きさは、内フード１６、回転軸４０側と、被処理物保持手段１８側の歯車比によって定めればよい。かくて、被処理物保持手段１８の振りによって、板状被処理物１７の被処理物保持手段１８への着脱を可能とする。

【００３７】被処理物保持手段１８の外周には中空で略環状体のフード２７が設けられる。前記被処理物保持手段１８に一体的に取り付けられ、被処理物保持手段１８と一緒に回転し、被処理物保持手段１８の回転により表遮蔽板１１と裏遮蔽板１５との間から遠心力で径方向外方に排出された処理後の流体を、表遮蔽板１１と裏遮蔽板１５との隙間を臨むフード２７の上部入口２８から受入れ、その方向をゆるやかに折り曲げて下方にガイドし、フード２７の下部出口２９から排出するようになっている。

【００３８】前記フード２７は、外フード１２と内フード１６とを径方向に間隔をずらして組み立てられる。断面図において外フード１２の上部は直線状をした下部から径方向内方へゆるやかに折り曲げられて、表遮蔽板１１の鍔状フード受部２２の下側に入り込んで、テーパ面２１の手前まで押込められている。したがって、外フード１２の上端の径は表遮蔽板１１の外径寸法よりも小さいが、被処理物保持手段１８上の保持部２４の取付け径よりも大きい。このように外フード１２の上端径を表遮蔽板１１の外径寸法よりも小さくしたのは、処理済みの流体を有効にフード２７内に捕捉するためであり、表遮蔽板１１の外径寸法よりも大きくすると、表遮蔽板１１との隙間から流体が漏れるおそれがあるからである。また、外フード１２の上端径を保持部２４の取付け径よりも大きくしたのは、被処理物面の処理領域を侵さないためであり、保持部２４の取付け径より小さくすると、処理前の流体がフード２７に流れて被処理物１７の終端部の処理に支障をきたすおそれがあるからである。

【００３９】外フード１２の内側に相似した形で配置される内フード１６によって流体が落ちても遠心力で、フード２７に取り込まれるようになっている。

【００４０】外フード１２と内フード１６の両下端で形成されるフード２７の下部出口２９は、非接触で環状の回収筒１３内に挿入されており、フード２７で捕捉されてフード２７内を重力もしくは吸引落下する処理済みの流体を回収できるようになっている。

【００４１】表、裏遮蔽板１１、１５の中心部に位置する供給口１９、２０より供給された流体は被処理物１７の表面、裏面を処理しつつ、被処理物１７の外周より排出される。排出された流体は外フード１２より、下方に曲げられ、あるいは重力、吸引によって内フード１６の表面に持たらされる。内フード１６は被処理物保持手段１８と共に回転しているので、排出された流体には遠心力が働き、被処理物保持手段１８ないし内フード１６の回転軸２５方向への流れを抑える。このため排出された流体は途中で逆流することなく、回収筒１３へ確実に回収される。

【００４２】なお、略環状体フード２７は被処理物保持手段１８と分離し、非回転であってもよい。

【００４３】回収筒１３は回転しない意味で固定であり、既述したように回転する内フード１６とは非接触である。なお、外フード１２は回転しない意味で固定であってもよいが、好ましくは、より回収効率を上げるために、内フード１６と連結して回転させるほうがよい。外フード１２も回収筒１３と非接触に保持される。また裏遮蔽板１５は回転しないので、裏遮蔽板１５に設けた供給口２０と、固定系である流体供給管２２との接続部３０は固着（リジッド）でよく、したがって接続部３０で摩擦粉を発生せず、漏れることがない。なお摩擦粉を発生せず、漏れることがなければ、リジッド結合以外の方法で連結してもよい。外フード１２、内フード１６の遠心力作用によって、表・裏遮蔽板１１、１５の間から排出された流体を漏らすことなく、回収筒１３に確実に回収することができる。

【００４４】次に図１と同様の高清浄な流体処理方法の他の実施の形態を図４に示す。図１では一体であった被処理物保持手段３８と内フード３６とを分離して、独立に回転制御できるようにしたことを除けば、図１の実施の形態と同じである。被処理物保持手段３８と内フード３６とは別体で構成され、回転軸３９、３７を同軸上にもち、それぞれモータ３２、３１と結ばれて独立回転するようにしてある。

【００４５】本来、被処理物保持手段３８を回転させる目的と内フード３６を回転させる目的とは異なる。前者は被処理物表面を均一に流体処理するためであり、後者は表・裏遮蔽板１１、１５の間から排出された流体に遠心力を作用させ、被処理物保持手段３８あるいは内フード３６の回転軸３９、３７方向への流れを抑えるためである。したがって被処理物保持手段３８よりも内フード３６の回転力は小さくて足りる。回転力が大きく、おおきな遠心力が加わると強度を高める必要が生じる。この

点で、内フード３６の回転力を被処理物保持手段３８よりも落とすことができるので、内フード３６ならびにこれと一体になっている内フード３６の材質に安価なプラスチックを使用することも可能となる。また、逆に被処理物保持手段１８の回転力を上げて遠心力をさらに稼いで性能をアップさせることも可能である。いずれにせよユーザの目的に合せた回転を選択できるので、内フード３６を回転させないようにすることも可能で、ユーザの使い勝手が向上する。なお、１つのモータで２つの回転軸３７、３９をギヤ伝達で回転してもよい。

【００４６】上述した図１～図４の実施の形態ではいずれも被処理物保持手段１８ないし被処理物１７が回転し、表遮蔽板１１および裏遮蔽板１５が固定されている場合について説明した。しかし、本発明は被処理物１７と表・裏遮蔽板１１、１５とが相対的に回転している場合に適用できる。相対的回転例としては、上記実施の形態の他に、被処理物保持手段および表・裏遮蔽板がともに回転する場合、被処理物保持手段が固定で、表・裏遮蔽板が回転する場合がある。ここでは、図５を用いて被処理物保持手段８３が固定で、表・裏遮蔽板８１、８２が回転する後者の場合の実施の形態を説明する。

【００４７】図５に示すものは、表・裏遮蔽板８１、８２が固定ではなく回転するようになっており、被処理物保持手段８３が回転せずに固定となっている点を除けば、基本的には図４の実施の形態と同じである。すなわち、被処理物保持手段８３からモータを取り去って被処理物保持手段８３を固定としている。表・裏遮蔽板８１、８２には、それぞれモータ８４、８５を取り付けて、表・裏遮蔽板８１、８２を同軸回転自在としている。ここに表・裏遮蔽板８１、８２を回転させるようにしたことから、回転系となる表裏遮蔽板８１、８２に設けた供給口１９、２０と、固定系となる供給管８９、９０との各接続部が問題になる。既述したように供給口１９、２０に流体が漏れることがないように接続すれば接続部が摩擦する。摩擦しないように接続すれば、接続部より流体が漏れるからである。しかし、接続部に摩擦の少ない軸受８６、８７を用いることで、摩擦の発生を低減し、摩擦粉が流体に混入することを有効に防止することができる。摩擦の少ない軸受８６、８７としては、例えば、磁気流体を用いた磁気流体軸受、流体膜を用いた流体膜軸受、供給管８９、９０を磁気で浮上せるとともに隙間を磁気流体ないし流体膜で埋めるようにした磁気軸受、さらには流体の動圧力により運動体を支持する動圧軸受、流体の静圧力により運動体を支持する静圧軸受、静圧軸受の中でも高精度の静圧空気軸受、複合形磁気軸受（吸引形もしくは反発形の永久磁石と少なくとも１組の能動形（電磁石電流を制御する）磁気軸受と組合せた構造）などがある。

【００４８】図４のものと比べてモータの数は増えるが、被処理物１７を挟んでいる表・裏遮蔽板８１、８２が、被処理物１７の両面で回転するので、供給される流体に強力な遠心力が作用するので、被処理物表面の流体処理の均一性が向上し、また処理済みの流体の排出効果も大きい。

【００４９】つぎに本発明の安価な流体処理方法と、高清浄かつ安価に流体処理する流体処理装置について図６を用いて説明する。

【００５０】流体処理装置の主要部は図１のものを使用した。流体処理液槽１１６はポンプ１０９およびバルブ１０８を介して表供給管１１７に流体処理液を供給できるようになっている。前記表供給管１１７には、前記流体処理液の他に、バルブ１０２を介して不活性ガスを、バルブ１０６を介して超純水などの処理流体を供給できるようになっている。

【００５１】回収筒１０３は配管１２１を介して分離器１１２に接続され、分離記１１２はポンプ１１４から冷熱機１１５をへてフィルタ１１３を通り、バルブ１１０を介して裏供給管１０４に接続され、これらで回収された流体の循環系１２０を構成している。そして、バルブ１１１を介して裏供給管１０４に前記表供給管１１７が連結されている。

【００５２】さて上記系統をもつ流体処理装置を用いた被処理物の流体処理方法を説明する。

【００５３】最初にバルブ１０８、１１０を開き、バルブ１１１を閉じ、流体処理液槽１１６より、ポンプ１０９で流体処理液を汲み上げ、表遮蔽板１０１より流体処理液を被処理物１０７に供給する。流体処理液は被処理物１０７の表面を処理しつつ被処理物１０７の端面より排出し、フード１１９で捕捉されて回収筒１０３に回収される。分離機１１２は、常に吸引排気されており、回収筒１０３の流体処理液は、外、内フード１１７、１１８と回収筒１０３の隙間から入る外気と共に吸引され、分離機１１２に導入される。流体処理液は分離機１１２内で自然に発生する渦流と重力によって分離機１１２の底に溜まる。流体処理液が分離機１１２に充満すると、外気と共に自動的に排出されていく。分離機１１２の底に溜まった流体処理液は、ポンプ１１４、冷熱機１１５、フィルタ１１３を通して、裏供給管１０４を通して裏遮蔽板１０５に供給され、被処理物１０７の裏面を流体処理しつつ、回収筒１０３に回収される。

【００５４】被処理物１０７の多くは、表面より裏面が、被処理物の搬送、保持などによって著しく汚染されている。したがって裏面を処理した流体を使って表面を処理することはできないが、表面を処理した流体を使って裏面を処理しても何ら、さしつかえない。また、裏面を処理した流体は、表面を処理した流体によって常に回収筒１０３で混合される。したがって、回収された流体はほぼ新鮮さが保持されており、これを循環させても裏遮蔽板１０５に供給される流体に汚染物質が蓄積されることはない。

【００５５】循環系１２０に組込まれた前記分離機１１２は、裏遮蔽板１０５へ流体を循環させる場合に、余分の流体を自動的に排出するためのもので、これにより循環系１２０を循環する流体の循環流量が自動調節されることになる。余分な流体を自動排出する必要がなければ、この分離機１１２は不要であり、単に気体と液体を分離すれば足り、逆浸透法、中空系法などを用いた気液分離機でもよい。また、冷熱機１１５は、流体処理液の温度を精密に制御する必要がなければ、特に必要としない。フィルタ１１３もまた被処理物１０７の汚染が小さければ特に必要とするものではない。要は、被処理物１０７の裏面を処理して回収した流体に、被処理物１０７の表面を処理した流体を加えることで、裏面を処理のための流体循環機能が発揮できればよい。

【００５６】よってバルブ１１０を閉とし、バルブ１０８、１１１を開として、流体処理液槽１１６より流体を表遮蔽板１０１と裏遮蔽板１０５の両方に供給し、これを回収し、分離機１１２より排出する。従来のものと比較して半分以下の流体消費量で済ますことが可能となり、しかも摩擦粉が混入せず、高清浄かつ安価な流体処理法を実現できる。なお、図６には、図示していないが分離機１１２より排出した流体は、さしつかえなければ、流体処理液槽１１６へもどして再利用してもよい。

【００５７】本発明はシリコンウェーハの洗浄への適用例として述べたが、板状被処理物の流体処理であれば、これに限定されるものではない。例えば、表遮蔽板、裏遮蔽板および板状被処理物に電流を流せるように、各構成材料を選択すれば、電解析出にも用いることができる。

【００５８】

【実施例】〈実施例１〉　本実施例では下記材料、部品、被処理物、流体、流体処理操作、評価を用いて行った。

（１）材料

・表遮蔽板１０１、裏遮蔽板１０５：厚さ２０ｍｍの高純度ガラス状カーボン製

・外フード１１７、内フード１１８：高純度炭化ケイ素系製

・回収筒１０３：ポリテトラフルオロエチレン（以後、ＰＴＦＥと称す）

（２）部品

・分離機１１２：直径５ｃｍのＰＴＦＥ製サイクロン

・ポンプ１０９、１１４：イワキ製ベローズポンプＦＡ－２Ｅ

・冷熱機１１５：コマツエレクロニクス製ＣＳヒータＡＩＨ－３３

・フィルタ１１３：日本ミリポア製全テフロンフィルター

・バルブ１０２、１０６、１０８、１１０、１１１：アドバンス製エアーオペレートバルブＳＡＶ－３２４０

・流体処理液槽１１６：２０リットル（ｌ）　ＰＴＦＥ槽

（３）被処理物

・被処理物は８インチウェーハで直径：２００ｍｍ、厚さ：０．７２５ｍｍ

抵抗率：６．０１～１２．０Ωｃｍの信越化学製である。

【００５９】このウェーハを粒径：約０．２μｍのシリコン粉を添加した５０％フッ素水素酸：水＝１：９９のフッ素水溶液に１５分間、浸漬して、ウェーハ表面に約６０００個のシリコン粉を付着させた。このシリコン粉の除去率から洗浄性能を求めた。

（４）流体

・流体処理液は２８％アンモニア水：３０％過酸化水素水：水＝１：２：７の水溶液。温度：８０℃。

・　不活性ガス：室温の窒素

（５）流体処理装置

表遮蔽版１０１を引き上げ、被処理物１０７を保持させ、表遮蔽板１０１を引き上げた。

【００６０】被処理物１０７を５００ｒｐｍで回転した。バルブ１０８、１１０を開とし、バルブ１０２、１０６、１１１を閉とし、流体処理液槽１１６より前記流体をポンプ１０９によって表遮蔽板１０１へ１．５リットル／ｍｉｎの流量で供給した。次いでサイクロン分離機１１２で、被処理物１０７の表面を処理した流体を分離、回収し、ポンプ１１４により、冷熱機１１５、フィルタ１１３を通して裏遮蔽板１０５へ１．５リットル／ｍｉｎの流量で循環供給した。

【００６１】この流体処理を３分間行った後、ポンプ１０９、１１４を停止し、バルブ１０８、１１０を閉じ、バルブ１０６、１１１を開けて超純水を表遮蔽板１０１、裏遮蔽板１０５に供給し、流体を３０秒間リンスした。次いで、バルブ１０６を閉じ、バルブ１０２を開とし窒素ガスを表遮蔽板１０１と裏遮蔽板１０５に供給すると共に、被処理物１０７の回転を１０００ｒｐｍとした。

【００６２】これを９０秒間行った後、バルブ１０２を閉とし、表遮蔽板１０１を引き上げ被処理物１０７のウェーハを取り出した。

（６）シリコン粉の除去率評価

上記流体処理後の付着数を日立電子エンジニアリング製のレーザ表面検査装置を用いて計測した結果、１０個／ウェーハ以下であり、極めて短時間に高清浄な流体処理されたことが判った。

〈実施例２〉以下に示す以外、用いた材料、部品、流体、流体処理操作、評価は〈実施例１〉と同じである。

（１）材料

・　裏遮蔽板１０５：厚さ２０ｍｍのポリテトラフルオロエチレン製

（２）被処理物

〈実施例１〉と同様のウェーハを用いた。このウェーハを２８％アンモニア水：３０％過酸化水素水：水＝１：２：７の水溶液中、８０℃にて、１０分間処理した。次いで、５０％フッ化水素酸：水＝１：９９のフッ酸水溶液に２分間、浸漬させて、ウェーハ表面の自然酸化膜を除去した。水洗後、ニッケルの原子吸光分析用の標準液を希釈した水溶液に３０分間、浸漬してニッケルの金属イオンで約10^{12}原子／cm^2汚染したウェーハを作成した。

（３）流体

３６％塩酸水：２０％過酸化水素水：水＝１：１：５の水溶液、

温度：８０℃

（４）流体処理操作

操作手順は〈実施例１〉と同じであるが、本実施例での流体処理時間は９０秒である。

（５）金属イオンの除去率の評価

上記処理後の金属イオンの付着数をテクノス製の全反射蛍光Ｘ線分析装置：ＴＲＥＸ６１０を用いて計測し、６×10^9原子／cm^2を得、迅速、高清浄に流体処理されたことが判った。

〈実施例３〉以下に示す以外、用いた材料、部品、被処理物、流体、流体処理操作、評価は〈実施例１〉と同じである。

（１） 部品

冷熱機１１５：コマツエレクトロニクス製　ケミカルサーキュレータ　ＮＥ－３３Ｃ－７

（２） 被処理物

〈実施例１〉と同様のウェーハを用いた。このウェーハ表面に段差付きのポリシリコンを付けた。

（３） 流体

５０％フッ化水素酸：水＝１：９９の水溶液。温度：室温。

（４） 流体処理操作

操作手順は〈実施例１〉と同様であるが、本実施例での流体処理時間は９０秒である。

（５） ウォータマークの評価

ウェーハを乾燥する時に発生する乾燥しみをウォータマークという。主たる発生原因はウェーハに付着した水滴に空気中の酸素が溶解してウェーハのシリコンを酸化、溶解し、溶解物が乾燥残渣として残ることによって生じる。

【００６３】このウォーターマークは直径１～１０μｍの大きさであり、日立製の電子顕微鏡Ｓ－７１００を用いて計測した。

【００６４】その結果、０～２個／cm^2であり、現在の主流の流体処理方法であるバッチ方式の約８個／cm^2と比較し高清浄な流体処理方法であることが判った。

【００６５】

【発明の効果】本発明方法によれば、被処理物表面を流体処理した流体を、回収し、循環して被処理物裏面にも供給することによって、安価で高清浄な流体処理を実現できる。

【００６６】また本発明装置によれば、表・裏遮蔽板を固定とし、被処理物のみを回転させることによって、表・裏遮蔽板への流体の供給を摩擦粉を発生することなく、高清浄な流体処理を実現できる。

【００６７】さらに本発明装置によれば、表・裏遮蔽板に対して被処理物保持手段だけを回転させるとともに、裏面処理を実行した流体を表面処理を実行した流体で希釈して被処理物裏面に循環させる循環系を設けるだけの簡単な構造で、上記方法の高清浄かつ安価な流体処理を実現できる。

【図面の簡単な説明】

【図１】実施形態による流体処理装置の構成図である。

【図２】被処理物保持部の要部を拡大した斜視図である。

【図３】実施形態の変形例の構成図である。

【図４】他の実施形態による流体処理装置の構成図である。

【図５】他の実施形態による流体処理装置の構成図である。

【図６】実施形態による流体処理装置と流体の循環を示す配管系統図である。

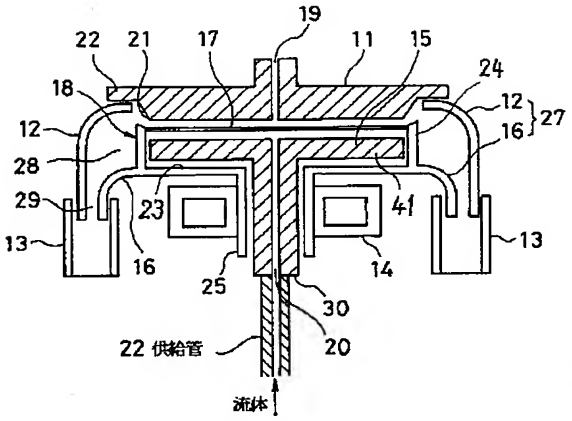
【図７】第１の従来例を示す構成図である。

【図８】第２の従来例を示す構成である。

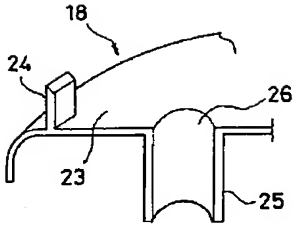
【符号の説明】

１１　表遮蔽板
１２　外フード
１３　回収筒
１４　モータ
１５　裏遮蔽板
１６　内フード
１７　被処理物
１８　被処理物保持手段
１９　供給口
２０　供給口
２２　供給管

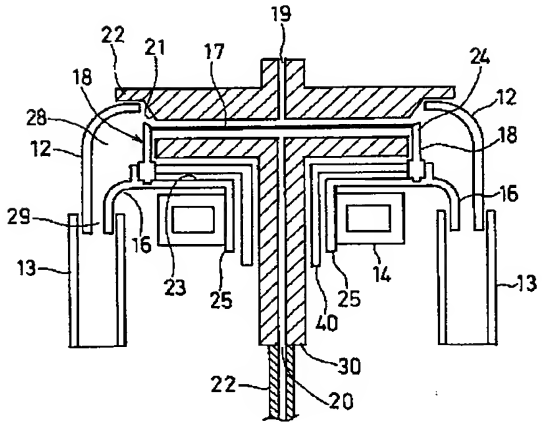
【図１】



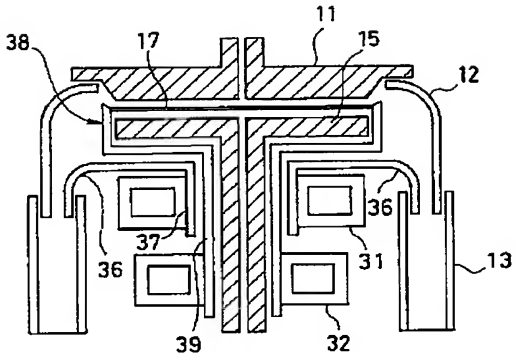
【図２】



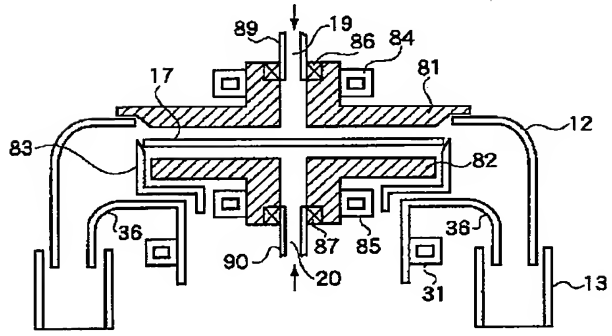
【図３】



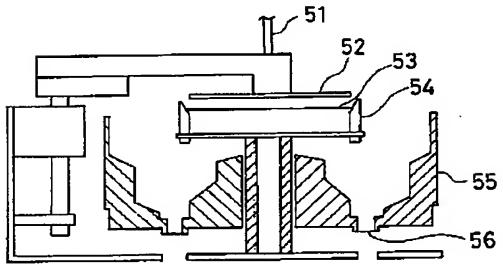
【図４】



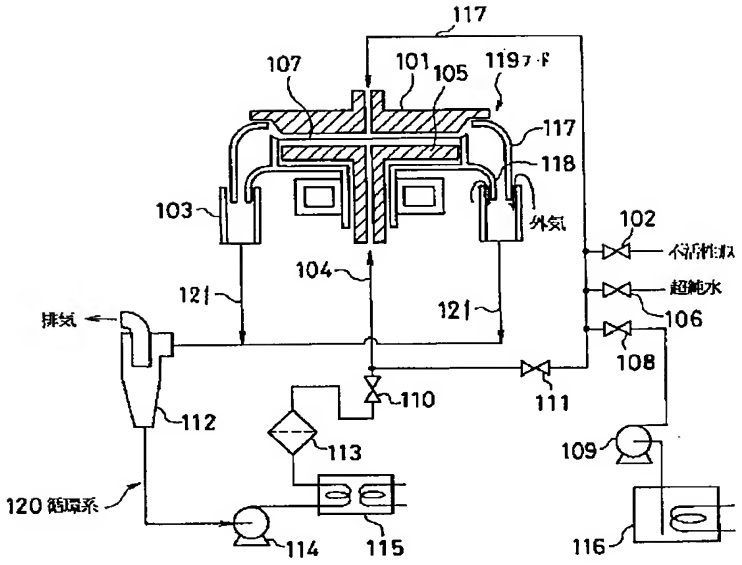
【図５】



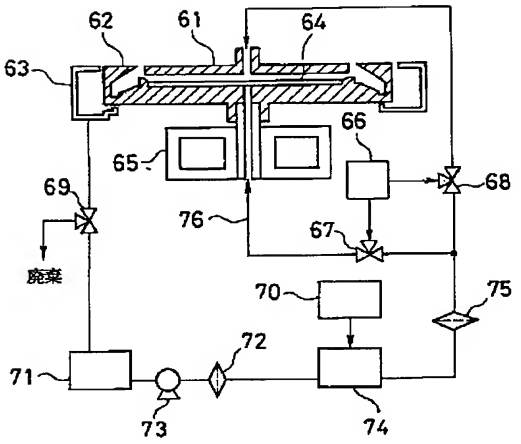
【図７】



【図６】



【図８】



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